

Sin embargo, la hembra consorte contribuyó mucho más en las actividades reproductivas que la hembra acompañante; ésta última no fue nunca observada trayendo presas al nido o cebando a los pollos con el alimento aportado por el macho.

[Traducción de los autores]

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#### TIMING AND ABUNDANCE OF MIGRANT RAPTORS ON BONAIRE, NETHERLANDS ANTILLES

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KEY WORDS: *American Kestrel*; *Falco sparverius*; *Swallow-tailed Kite*; *Elanoides forficatus*; *Yellow-headed Caracara*; *Milvago chimachima*; *migration*, *Caribbean*.

The island of Bonaire (12°10'N, 68°18'W) in the south Caribbean Sea, 87 km north of Venezuela, is the easternmost island of the Netherlands Antilles. Bonaire occupies a land surface of ca. 272 km<sup>2</sup>, its climate is arid, and the island is largely covered in xerophytic and thorny bush and sparse woodland. Some 181 species of birds have

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Table 1. Records per month of migrant raptors in Bonaire, Netherlands Antilles. The migration peaks twice a year in February and October–November.

SPECIES	J	F	M	A	M	J	J	A	S	O	N	D
Pandionidae												
Osprey ( <i>Pandion haliaetus</i> )	7	7	2	5	9	5	6	3	11	12	15	5
Accipitridae												
Swallow-tailed Kite ( <i>Elanoides forficatus</i> )				1								
Falconidae												
Yellow-headed Caracara ( <i>Milvago chimachima</i> )												1
American Kestrel ( <i>Falco sparverius</i> )		1	1		1		2				1	1
Merlin ( <i>Falco columbarius</i> )	9	6	7	6		1	2		1	8	14	4
Peregrine Falcon ( <i>Falcon peregrinus</i> )	1	9	7	4				1	1	10	10	5
Total	17	23	17	16	10	6	10	4	13	30	40	16

been listed for Bonaire (Voous 1983). Although the island is ornithologically relatively well explored, the number of new migrants recorded on the island is still increasing (e.g., Prins and Debrot 1996).

Two species of raptors breed on the island, and an additional three species are regular nonbreeding visitors (Voous 1982, 1983, 1985). Resident raptors have been studied infrequently. The migrants have not been subjected to any systematic observations (Voous 1957, 1982), nor is there a monitoring scheme in place. As such, Bonaire is typical for the region for which Zalles and Bildstein (2000) commented “With few watch-sites, movements of raptors in (the Caribbean) are decidedly less well understood than they are farther north in the Western Hemisphere. As a result, (the region) ranks as the least studied region in the world in this regard.” Furthermore, spatial and temporal variation in the abundance of migrant raptors in the tropics has been rarely quantified (Thiollay 1978, Nijman 2001), largely because few monitoring programs are in place. We compiled information on the avifauna of Bonaire. Our aim was to provide details on the species composition of migrant raptors on Bonaire and to analyze their timing and abundance on the island.

METHODS

Data on the occurrence of raptors in the Netherlands Antilles were compiled from: (1) the collections of the Zoological Museum Amsterdam (ZMA) and Naturalis Leiden (RMNH); (2) records from the archives of the late K.H. Voous and the late Brother Candius van der Linden (both stored in the ZMA), of whom the latter was resident on Bonaire from 1967–95; and (3) data solicited from ornithologists and observers on the island. Temporal distribution of the occurrence of migrant raptors was very similar in these three data sets, so we pooled

them for further analysis. We define Bonaire as the island of Bonaire and the islet of Klein Bonaire, but we do not include Isla las Aves situated ca. 60 km to the east. Given that for many of the migrants arriving in the Netherlands Antilles we have no data on their specific breeding localities, following Voous (1983) we define migrant in its broadest sense and include all species that do not have a resident breeding population on Bonaire. We used  $\chi^2$ -tests to evaluate differences in the temporal distribution of records by comparing monthly totals. Means are reported  $\pm 1$  SD and significance is assumed when  $P < 0.05$  in a two-tailed test.

RESULTS

We compiled 202 records for six species of migrants on Bonaire (Table 1). The mean number of records was 16.8 ( $\pm 10.2$ ) per mo or 33.7 records ( $\pm 36.0$ ) per species. On average, 3.3 ( $\pm 1.0$ ) species of migrant raptor per mo are present on the island, ranging from 2–5. The records were not equally distributed over the year, and most migrants were observed during the boreal winter ( $\chi^2 = 67.7$ ,  $df = 1$ ,  $P < 0.001$ ; Table 1). If we expected a uniform temporal distribution, each of the months of February, October, and November had significantly more records than the other months combined (all  $\chi^2 > 7.5$ ,  $df = 1$ ,  $P < 0.01$ ). Conversely, each of the months May–August have significantly fewer records than the other months combined (all  $\chi^2 > 4.2$ ,  $df = 1$ ,  $P < 0.05$ ).

More than 40% of the records refer to the Osprey (*Pandion haliaetus*). The three least common species (Swallow-tailed Kite [*Elanoides forficatus*], Yellow-headed Caracara [*Milvago chimachima*], and American Kestrel [*Falco sparverius*]) make up only 4% of the total sample. The Osprey was the only nonbreeding raptor recorded in all months, although three records of the Merlin (*Falco*

*columbarius*) in June and July suggested that a small number of these migrants may have remained on the island during the boreal summer.

#### DISCUSSION

**Species Composition.** We documented six species of migrant raptors on Bonaire, three of which were not included in Voous' (1983) list of birds for the island. We documented seven records of American Kestrel from all seasons dating as far back as 1948. The species is common in the region and probably was a regular visitor to Bonaire, although Voous (1957, 1983) was reluctant to accept any records of the species. Records of the other two species were more recent, the Yellow-headed Caracara in December 1996, and the Swallow-tailed Kite in April 2002 (Mlodinow 2004). The former occurs throughout northern South America (Ferguson-Lees and Christie 2001). In the Netherlands Antilles it previously has been recorded on Curaçao only (January 1952; Voous 1983). The Swallow-tailed Kite has a disjunct distribution and breeds in the southern United States (now mainly Florida and adjacent states) and from southern Mexico south to Argentina (Ferguson-Lees and Christie 2001). Kites from northern and central America migrate southwards during the boreal winter, whereas little is known about movements of populations in northern South America. Recently, the species was recorded on Aruba (March 2003; Mlodinow 2004), suggesting that the sighting on Bonaire might not be as unusual as previously thought. In addition to these species, observations of a Northern Harrier (*Circus cyaneus*) on Curaçao (October–November 1997) suggested that this northern migrant also can be expected to pass through Bonaire (B. de Boer pers. comm.).

All of the migrants from Bonaire have been recorded on the other islands in the Netherlands Antilles, and one, the American Kestrel, breeds on Aruba and Curaçao (Voous 1983). Two of the species, the Osprey and the Peregrine Falcon, are known from the Los Roques Islands east of Bonaire (Zalles and Bildstein 2000).

**Timing of Migrant Raptors.** Several distinct phases can be recognized with respect to the timing of northern migrant raptors on Bonaire. The first phase from September–November was characterized by the arrival and passage of a relatively large number of migrants, presumably mostly from North America, en route to mainland South America. In December and January, the number of records was considerably lower and these, in part, likely represented birds that over-winter on the island. The second, albeit smaller, peak from February–March probably comprised birds on return migration to their breeding grounds. Finally, a small number of individuals remained on the island in boreal summer from April–August. A similar temporal pattern has been observed in migrant passerine birds in xerophytic habitats on the Paraguaná Peninsula, Venezuela, 150 km west of Bonaire (Bosque and Lentino 1987), that is a conspicuous fall migration,

little overwintering, but with an even less conspicuous spring migration.

Most migrant raptors arriving on Bonaire breed in northern latitudes, although a small number (i.e., Yellow-headed Caracara and, most likely, Swallow-tailed Kite; Mlodinow 2004) originate from mainland South America (Venezuela, Colombia). Few data are available on movements of raptors in northern South America, but at least some are partly migratory (French 1973; Ferguson-Lees and Christie 2001). One species, the American Kestrel is a breeding resident on Aruba and Curaçao, where its main breeding season is November–February (Voous 1957, 1983). The few records we compiled from Bonaire were from throughout the year, but may well have been either first-year birds dispersing from these nearby islands, or alternatively, birds from northern regions.

Systematic studies of raptor migration on Caribbean islands are rare, and compared to other parts of the Northern Hemisphere little is known about the species composition and timing of migrants in the region (Zalles and Bildstein 2000). Our data set was comprised of records obtained opportunistically, and includes the island of Bonaire only. Extending our analysis to other islands in the south Caribbean islands and to mainland areas in northern South America (including the Paraguaná Peninsula) may be a promising avenue along which to proceed with further research.

#### TEMPORADA DE ESTANCIA Y ABUNDANCIA DE AVES RAPACES EN BONAIRE, ANTILLAS HOLANDESES

**RESUMEN.**— Se colectaron 202 registros de seis especies de aves rapaces de la isla de Bonaire, Antillas Holandesas, incluyendo tres especies reportadas nuevamente en la isla (*Elanoides forficatus*, *Milvago chimachima* y *Falco sparverius*). Basándonos en estos datos discutimos la temporada de estancia y la abundancia de rapaces migratorias en la isla. La abundancia máxima de migrantes tiene lugar dos veces al año durante febrero y marzo (20% del total anual) y durante octubre y noviembre (35%), similar al patrón observado en las cercanías de Venezuela. Se identificaron tres grupos de aves rapaces migratorias. El primero, migrantes de Norte América que pasan por Bonaire hasta llegar a las planicies de Sudamérica; el segundo, especies que se dispersan por Sudamérica hasta llegar a Bonaire; y el tercero, residentes que se alimentan cerca de las islas y que ocasionalmente se registran en Bonaire.

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## THE RELATIONSHIP OF FORAGING HABITAT TO THE DIET OF BARN OWLS (*TYTO ALBA*) FROM CENTRAL CHILE

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**KEY WORDS:** *Barn Owl*; *Tyto alba*; diet; Chile; feeding ecology; anthropogenic disturbance.

Several studies on the diet of the Barn Owl (*Tyto alba*) related to broader investigations of predator-prey relationships have been conducted in Chile, most of which involved data collected in the semi-arid north-central zone of this country (e.g., Schamberger and Fulk 1974, Jakšić et al. 1992, 1993b). The majority of these studies dealt with predator-prey interactions, and little attention was paid to human influences on the Barn Owl's diet (e.g., Schlatter et al. 1980, Simeone 1995). Indeed, most of these studies were conducted in areas of reduced human activities such as the Fray Jorge National Park

(Schamberger and Fulk 1974, Fulk 1976, Jakšić et al. 1993b), the Chinchilla National Reserve (Jakšić et al. 1992), or the Atacama Desert (Jakšić et al. 1999). Disturbances of hunting habitats by human activities such as agriculture or pollution may differentially affect the occurrence or abundance of small mammals, and thus, the diet of the Barn Owl.

In this study, I examine the diet of Barn Owls occupying two ecologically-dissimilar study areas. Although both sites are affected by humans, their extent of disturbance differs. One study site (El Alamo), located in the south of central Chile, consisted mainly of meadows and was only slightly influenced by human settlement. In contrast, the second habitat (Los Maitenes) appeared to be noticeably polluted by the copper-processing industry as indicated by substantially reduced vegetative cover. Furthermore, the polluted habitat lies within the geograph-

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